NINETEENTH ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE.

1903.

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The Bulletins of this Station will be sent free to any address in Maine. All requests should be sent to

Agricultural Experiment Station,
Orono, Maine.

STATE OF MAINE.

Geo. E. Fellows, Ph. D., President of the University of Maine:

SIR:—I transmit herewith the Nineteenth Annual Report of the Maine Agricultural Experiment Station for the year ending December 31, 1903.

CHARLES D. WOODS,
Director.

ORONO, ME., December 31, 1903.

MAINE

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ORONO, MAINE.

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* Until July 1, 1903.
† Resigned June, 1903.
‡ Appointed July, 1903.
§ Died, 1903.

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ANNOUNCEMENTS.

THE AIM OF THE STATION.

Every citizen of Maine concerned in agriculture has the right to apply to the Station for any assistance that comes within its province. It is the wish of the Trustees and Station Council that the Station be as widely useful as its resources will permit.

In addition to its work of investigation, the Station is prepared to make chemical analyses of fertilizers, feeding stuffs, dairy products and other agricultural materials; to test seeds and creamery glass-ware; to identify grasses, weeds, injurious fungi and insects, etc.; and to give information on agricultural matters of interest and advantage to the citizens of the State.

All work proper to the Experiment Station and of public benefit will be done without charge. Work for the private use of individuals is charged for at the actual cost to the Station. The Station offers to do this work only as a matter of accommodation. Under no condition will the Station undertake analyses, the results of which cannot be published, if they prove of general interest.

INSPECTIONS.

The execution of the laws regulating the sale of commercial fertilizers, concentrated commercial feeding stuffs, and agricultural seeds, and the inspection of chemical glassware used by creameries is entrusted to the Director of the Station. The Station officers take pains to obtain for analysis samples of all brands of fertilizers and feeding stuffs coming under the law, but the organized co-operation of farmers is essential for the full and timely protection of their interests. Granges, Farmers' Clubs and other organizations can render efficient aid by reporting any attempt at evasion of the laws and by sending, early in the sea-

son, samples taken from stock in the market and drawn in accordance with the Station directions for sampling. In case there should be a number of samples of the same brand sent in, the Station reserves the right to analyze only in part.

STATION PUBLICATIONS.

The Station publishes several bulletins each year, covering in detail its expenses, operations, investigations and results. The bulletins are mailed free to all citizens who request them.

CORRESPONDENCE.

As far as practicable, letters are answered the day they are received. Letters sent to individual officers are liable to remain unanswered, in case the officer addressed is absent. All communications should, therefore, be addressed to the

Agricultural Experiment Station,
Orono, Maine.

The post office, railroad station, freight, express and telegraph address is Orono, Maine. Visitors to the Station can take the electric cars at Bangor and Old Town.

The telephone call is "Orono 5."

Directions, forms and labels for taking samples, of fertilizers, feeding stuffs and seeds for analysis can be had on application.

Parcels sent by express should be prepaid, and postage should be enclosed in private letters demanding a reply.

CHAS. D. WOODS, *Director.*

LIST OF BULLETINS PUBLISHED IN 1903.

89. Experiments in Orchard Culture.
90. Fertilizer Inspection.
91. The Chinch Bug in Maine.
92. Feeding Stuff Inspection.
93. Poultry Experiments in 1902.
94. Fertilizer Inspection. Top-dressing Grass Lands with Chemicals.
95. Dandelion. Hawkweed. Ginseng. Cankerworm.
96. Plant House Aleyrodes.
97. Wheats and Flours of Aroostook County.
98. Potato Experiments in 1903. Notes on the Angora Goat. The Preservation of Hen Manure.
99. Finances. Meteorology. Index.

Maine Agricultural Experiment Station

BULLETIN No. 89. FEBRUARY, 1903.

EXPERIMENTS IN ORCHARD CULTURE.

This bulletin contains notes upon the relative merits of different treatments of orchards, including culture and mulching; the effect of potash on apple scab; orchard renovation, and top-grafting.

Requests for bulletins should be addressed to the
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EXPERIMENTS IN ORCHARD CULTURE.

W. M. Munson.

In accordance with the general policy of the Experiment Station, of conducting practical experiments in those sections of the State best suited to the particular industry under consideration, the orchard of Mr. Chas. S. Pope, of Manchester, has for several years been used in the study of orchard pests and, during the past four years, in the study of various cultural problems. The orchard is situated in the heart of one of Maine's best orchard counties—Kennebec—and is much better suited for the purposes hereinafter mentioned than is the Station orchard at Orono. At the outset the writer wishes to acknowledge the uniform courtesy and helpful counsel of Mr. Pope and the faithfulness with which he has carried out the details of the work—often at a great personal sacrifice.

I. Culture and Fertilizers.

For a study of the comparative effects of cultivation and mulch, as well as the use of stable manure and commercial fertilizers, in the development and fruiting of apple trees, a young orchard of Tallmans and Gravensteins was selected in 1898. The trees were 8 to 10 years old at the beginning of the experiment.

HISTORY OF THE ORCHARD.

The trees were planted 25 x 30 feet apart as follows: three rows on the south, next to the old orchard, in 1888; the next row, 1889; rows five to eight, 1890. The soil was a rocky, sandy, virgin loam pasture with an eastern aspect. No cultivation was given and no special attention paid to the orchard, except to keep out the borers and give an occasional mulching, until May, 1898, when the work was taken up by the Experiment Station.

That portion of the orchard adjacent to the plot selected is planted to Kings, and remains in the condition the whole orchard was in at the commencement of the experiment.

In May, 1898, steamed bone, at the rate of 500 pounds per acre, was sown broadcast over the whole area. Twenty-eight trees (see plan of orchard, page 4) received a high grade complete fertilizer—Bradley's XL—in the proportion of 5 pounds, 10 ounces per tree on an area with a 10 foot radius; or at the rate of 800 pounds per acre. A like number of trees received a heavy dressing of stable manure—1-10 cord per tree—on an equal area, of 10 feet radius. In accordance with the plan, one-half of each lot was placed under thorough cultivation, and the other half heavily mulched with meadow hay or sawdust. Owing to a severe raid by the forest tent-caterpillar, the work of cultivation was neglected the first season.

In 1899, complete fertilizer and manure were applied, as before. The cultivated portion was thoroughly tilled and the trees made a vigorous growth. Both lots were markedly better than the adjacent untreated trees, as shown in figures 1, 2 and 3.

In 1900, fertilizer and manure were applied as before. The mulch was renewed and cultivation was continued during the season. There was a moderate crop of fruit, but, owing to the absence of the writer, no record of the yield was made.

In 1901, fertilizer was applied, but no manure. The season was very dry, but trees made a fair growth. There was no fruit except a few Gravensteins.

In 1902, neither fertilizer nor manure were applied. The mulch seemed sufficient, as all grass and weeds on mulched areas were held in check. The cultivated portion was plowed in June, and harrowed twice during the summer. The season was moist and many of the trees produced very satisfactory crops, though there was a great variation as shown by the subjoined notes.

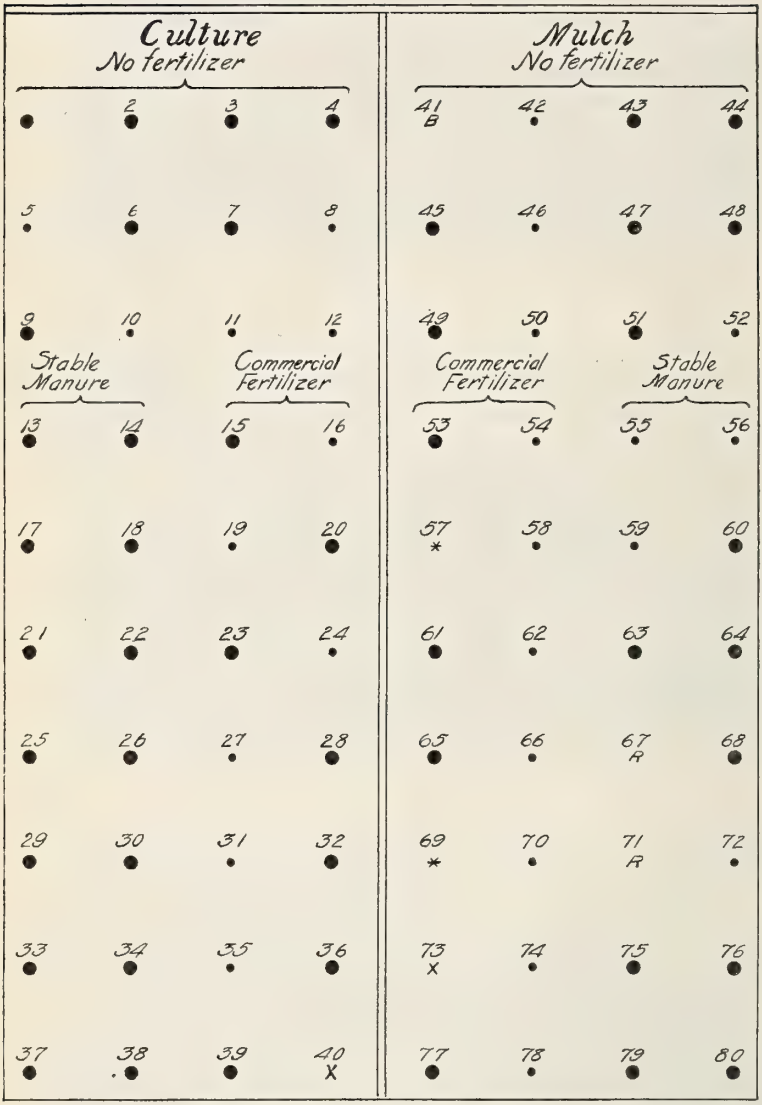
The diagram on page 4 will serve, better than words, to convey an idea of the relation of the trees mentioned in succeeding notes, also to indicate clearly just which trees produced fruit this year.

Figure 1. Untreated

Figure 2. Mulched.

Figure 3. Cultivated.

DIAGRAM OF THE ORCHARD.



Explanation of Diagram: The significance of the figures in the above diagram is as follows: ● = trees bearing in 1902; • = trees not bearing in 1902; × = vacancy; * = Bellflower tree; R = Roxbury Russet; B = Ben Davis.

GROWTH AND CONDITION OF THE TREES, 1902.

The writer made a careful inspection of the orchard on September 12, and noted the present condition of every tree. Hereafter such inspection will be made each year, that the individual characteristics of the trees may be determined, and the annual yield of the different plots recorded. The following notes are transcribed from the field records and give a better idea of the condition of the orchard than would be possible in a mere summary.

GROWTH AND CONDITION OF TREES ON CULTIVATED AREA.

Number of tree.	Growth in inches.	Crop.	Remarks.
1	6-8	Fair.....	Spreading; good, vigorous tree.
2	6-8	Fair.....	Spreading; good tree, but not equal to No. 1.
3	8-10	Fair.....	Vigorous, upright, spreading; good form.
4	6-8	Small	Vigorous, spreading.
5	8-10	....	Vigorous, upright; a fine tree.
6	4-6	Medium ..	Moderately vigorous; has been injured by borers.
7	8-10	Medium ..	Younger than the other trees; injured by borers.
8	10-14	.....	Spreading; a fine tree.
9	8-10	Full	Spreading, vigorous; good tree; fruit dropped off early.
10	10-12	....	Spreading, vigorous; good tree.
11	6-8	.....	Spreading, vigorous.
12	10-12	....	Upright, vigorous.
13	8-10	Good.....	Fine tree, vigorous.
14	8-10	Good.....	Fine tree, vigorous.
15	8-10	Small	Fine tree, vigorous.
16	4-5	.....	Rather small.
17	8-10	Medium ..	Fine tree; full crop 1901.
18	6-8	Medium ..	Fine tree.
19	6-8	Small	Fine tree; half a dozen fruits.
20	8-10	Small	Good tree, but not large.
21	10-12	Full	Fine tree.
22	0	Full.....	Tree dying; defective stock.
23	10-12	Small	Fine tree; vigorous.
24	6	Small	Fine tree; vigorous; half a dozen fruits.
25	6-7	Full	Spreading habit; one-half of tree in Roxbury Russet.
26	6-8	Medium ..	Upright, stock defective; set in 1892.
27	12	....	Upright, vigorous.
28	4-6	Full	Spreading; large amount of fruit, thinned.
29	6-8	Medium ..	Spreading, vigorous.
30	6-8	Medium ..	Spreading, vigorous.
31	10	.....	Upright, vigorous.
32	12	Small	Upright, spreading, vigorous.
33	8	Full	Spreading.
34	10	Small	Upright, vigorous.
35	6-8	.....	Spreading.
36	8	Medium ..	Spreading; stock defective; dying.
37	6-8	Small	Upright, vigorous.
38	7-8	Medium ..	Spreading.
39	8	Medium ..	Spreading.
40	.....	.....	Dead.

GROWTH AND CONDITION OF TREES ON MULCHED AREA.

Number of tree.	Growth in inches.	Crop.	Remarks.
41	8-10	Full.....	*Ben Davis.* Fruit small; tree making fair growth.
42	4-6	.....	Upright, spreading; fair tree.
43	4-6	Medium ..	Spreading; a good tree.
44	6-8	Medium ..	Spreading; a good tree.
45	8-10	Medium ..	Spreading; a fine tree.
46	2-4	.....	Fair tree; attacked by borers.
47	4-6	Full.....	Spreading; good tree; close by side of a large boulder.
48	3-6	Small.....	Small tree; spreading.
49	8-10	Full	Upright; spreading, vigorous; very fine tree.
50	2-3	.....	Fair tree; attacked by borers.
51	6-8	Small.....	Spreading, vigorous.
52	2-3	.....	Set later than others; moderately vigorous.
53	6-8	Small. ...	Good tree.
54	3-5	.....	
55	4-6	.....	Vigorous; fine tree.
56	8-10	.....	Vigorous; fine tree.
57	10-12	Small	*Bellflower.* Vigorous; fine tree, but fruit knotty and poor.
58	5-6	.....	Good tree.
59	4-6	.....	
60	5-6	Medium ..	Good tree.
61	6-8	Medium ..	Vigorous.
62	4-6	.....	Vigorous.
63	8-10	Small.....	Vigorous; fine tree.
64	10-12	Small.....	Vigorous; fine tree.
65	10-12	Full.....	Spreading, vigorous; a good tree.
66	2-4	.....	Healthy, no apparent reason for small growth.
67	10-12	... .	*Roxbury Russet.* Good tree.
68	8-10	Medium ..	Spreading, vigorous.
69	12-14	Medium ..	*Bellflower.* Very vigorous; low head, giving forest conditions to soil.
70	8	.....	Vigorous.
71	5-7	.. ..	*Roxbury Russet.* Spreading, vigorous.
72	6-8	.....	Spreading, vigorous.
73	.....	.....	Vacant.
74	1-3	....	Good tree; larger than some on cultivated plot.
75	6	Small.....	Upright.
76	6-8	Full	Spreading; fair tree.
77	10-12	Full	Spreading, vigorous.
78	4-6	.....	Good tree.
79	8-10	Medium ..	Upright, vigorous; good tree.
80	8-10	Medium ..	Vigorous, spreading.

In the above notes Numbers 1-12 and 41-52 inclusive received no fertilizer of any kind. But the first mentioned trees were cultivated, while the second were mulched, as before mentioned. Numbers 13-24 and 53-64 respectively are Tallman. The remainder, except as noted, are Gravenstein.

As will be observed, there is a wide variation in the growth of trees receiving the same treatment. In general, however, the trees on the cultivated area made a better showing than those on the mulched land; though the latter, in the absence of trees for comparison, would be regarded as good, vigorous trees. It will further be noted that the number of unfruitful trees on the

cultivated portion of the orchard was but half that on the mulched area. On both areas, among the Gravenstein trees, were to be found two very different types of growth, *viz.*, distinctly upright and broadly spreading: shown in figures 4 and 5. Between these extremes were other forms combining the characteristics of both. It will be interesting in the future to note whether there is a difference in the yield and characteristics of the product of the two forms. No special difference was observed this year.

Figure 4. Gravenstein tree, upright form.

Figures 6 and 7 illustrate, more clearly than words can tell, the advantage to young orchards of thorough cultivation. Figure 6 shows, in the foreground, one of the Tallman trees on the cultivated plot as it appeared at the end of the first season of thorough culture. The rocky character of the soil and the marked vigor of growth are the most noticeable features. In figure 7 is shown the same tree three years later—September, 1902. The tree bore, this year, a little more than two barrels of fruit, of excellent quality. Further comment is unnecessary.

NOTES ON THE GROWTH OF TREES, 1902.

The following summary of the actual growth of the trees on the several plots under observation may be of use in future studies.

Variety.	Treatment.	Growth in inches; unfertilized.	Growth in inches; stable manure.	Growth in inches; commercial fertilizer.
Gravenstein	Cultivated ..	7½–9⅔ (12 trees)	7 –8 (8 trees)	8½– 9 (7 trees)
	Mulched	5½–7½ (9 ")	7 –8½ (6 ")	10 –12 (2 ")*
Tallman.....	Cultivated ..	.....	6⅔–8½ (6 ")	7 – 8½ (6 ")
	Mulched	2⅔–4⅛ (3 ")	6½–8⅛ (6 ")	5 – 6½ (5 ")

*These trees were in a slight depression and next to the cultivated area.

Figure 5.—Gravenstein tree, spreading form.

With a single exception, in which two trees had particularly good advantages, the growth on the mulched areas was less than on corresponding cultivated plots. On cultivated soil there was little increase in growth from the use of either manure or commercial fertilizer; while on the mulched land the growth was noticeably (2 to 5 inches) greater, as a result of adding plant foods. These facts would indicate that there is enough plant food in the soil to produce a fairly satisfactory growth if the mechanical treatment is such as to render it available, and other plants are not allowed to rob the trees.

The above facts are worthy of more than passing notice. The physical condition of soil is nearly always of more importance than mere richness in plant food. The chemical composition of a soil is not necessarily a measure of its productive capacity, since plant food is of no consequence unless the plant can make use of it. If now, there is sufficient material available to produce only a stunted growth of trees and grass at the same time, it is evident that the surface application of additional food may temporarily stimulate the growth of both. Hard, lumpy soils, however, will not produce good crops, no matter how much fertilizer may be applied, and there is no doubt that the number of "worn-out" farms in New England is much smaller than is generally

Figure 6. Cultivated plot in 1899. Tallman in the foreground.

supposed. The average New England hillside contains a sufficient amount of food material, or nearly so, to insure good crops if the land is properly handled; and tillage, by improving the texture of the soil, is the key to unlock this store of wealth. By fining the soil, and thus increasing the feeding surface for the roots; by increasing the depth, and thus giving a greater foraging area; by warming and drying the soil in the spring; and by reducing the extremes of temperature and moisture, the physical condition will be rendered best for giving up the accumulated plant food. The increased water holding capacity

of the soil, as a result of tillage, is also an important factor in successful crop production, since, as a rule, the amount of water which falls during the growing season is entirely inadequate for the growth of plants during that time.

Figure 7. Cultivated plot in 1902. Tallman shown in figure 6 in the foreground.

Naturally those soils which are open and porous, which contain a large number of spaces between the particles, will retain the moisture to better advantage, and will give better opportunity for the roots of plants to penetrate them and take up the food-laden moisture there stored, than will a compact soil—in the same way that a sponge will take up a larger amount of moisture than a block of wood. By deep plowing, thorough working, and the addition of organic matter by means of cover crops, this spongy condition desired is obtained, and the growth of orchard crops as well as of farm and garden crops is fostered.

But not all New England orchards are susceptible of cultivation. In such cases some other method of treatment must be devised. A heavy mulch of hay, leaves or sawdust (preferably not fresh sawdust) conserves the moisture and prevents the growth of robber plants—weeds; to this extent favoring growth of trees. The roots, however, are developed near the surface and in time of severe drought, especially if the mulching is not

carefully renewed as required, the trees are liable to injury. The best treatment of such a rocky hillside as is shown in figure 8, is to fence off a portion of the orchard each year, turn in hogs and let them thoroughly work the soil. An added advantage of this treatment is the destruction of diseased and infested fruit. The testimony of orchardists who have practiced this treatment is, invariably, to the effect that the injury by the apple maggot (Trypeta) is greatly reduced.

Figure 8. An orchard not easily cultivated.

YIELD OF FRUIT, 1902.

The question of supreme importance, after getting a satisfactory growth of trees, is the quantity and quality of the product. As already noted, the present season is the first that the trees in question have fruited to any extent and, as might be expected, there was great variation in the amount and character of the fruit. The largest amount on any tree was about two barrels, and the quantity varied from that amount to half a peck. The following table gives a summarized statement of the yield on different plots, together with the number of trees producing fruit.

YIELD OF FERTILIZED AND UNFERTILIZED TREES, 1902.

Variety.	Treatment.	Unfertilized.	Stable manure.	Commercial fertilizer.
Gravenstein..	Culture	4½ bbl. (7 trees)....	7⅔ bbl. (8 trees)...	1½ bbl. (4 trees).
	Mulch	2½ bbl. (8 trees)....	1⅔ bbl. (5 trees)...	4 bbl. (2 trees).
Tallman	Culture	.....	3⅔ bbl. (6 trees)...	⅔ bbl. (3 trees).
	Mulch	.....	1¼ bbl. (3 trees)...	1¾ bbl. (3 trees).

The above figures are of interest as showing the variation mentioned; but, of course, no conclusions can be drawn. The facts are published for purposes of record.

Leaving aside the question of fertilizers, it will be seen from the table given that, on the cultivated and mulched areas respectively, the following interesting results were obtained.

Variety.	Treatment.	Number of trees bearing.	Barrels of fruit produced.	Average per tree.
Gravenstein .	Culture	19	13.75	.72
	Mulch	14	8.25	.59
Tallman.	Culture	9	4	.44
	Mulch	6	3	.50

In case of the Gravensteins, the number of trees producing some fruit was nearly 50 per cent greater on the cultivated than on mulched land; and the average yield per tree was 72 per cent on the cultivated as opposed to 59 per cent on the mulched area. With Tallman the number of bearing trees is greater by one-half on the cultivated area, but the average yield is slightly less. It should be said, however, that most of the Tallman fruit on the cultivated area came from four trees; the remaining trees, in most cases, having not more than half a peck each. This feature of the experiment will be watched with interest in future work.

II. Do Potash Fertilizers Affect the Quality of Fruit?

To determine the influence of different salts of potash upon the character and chemical composition of fruit, as well as upon its susceptibility (if any) to fungous attack, a young Baldwin orchard was selected. The orchard, about twenty-five years old at the beginning of the work, is located on a good sandy loam soil, with a slightly southern or southeastern aspect. That por-

tion of the orchard under consideration includes 45 trees, covering an area of .93 acre.

As shown by the accompanying plan the trees were divided into four lots, *viz.:* 10 trees receive an excess of muriate of potash; 10 receive sulphate; 10 receive kainite; and 15 are left without special potash treatment. The orchard is kept under clean cultivation.

EFFECT OF POTASH SALTS.—DIAGRAM OF ORCHARD.

HISTORY OF THE ORCHARD.

The trees were set (25x25 feet) in 1881-3, in a cultivated field. The land was kept under cultivation for four or five years and cropped with corn and beans. It was then thrown into a sheep pasture and left without treatment until 1891, when Professor Balentine started some work relative to the effect of Thomas slag and crude South Carolina rock. At this time, 1891, each row of five trees received an application of 15 lbs. nitrate of soda, 10 lbs. of muriate of potash and 50 to 130 lbs. of Thomas

slag or South Carolina rock. The fertilizers were applied as a top dressing in the sheep pasture.

In 1893, no satisfactory growth being made, Professor Balentine's experiment, with his consent, was abandoned. An application of stable manure was then made and the orchard was plowed. It was seeded down the next year, however, and remained without further attention until 1898.

In May, 1898, the orchard was plowed and harrowed. Steamed bone at the rate of 500 pounds per acre, was applied broadcast over the whole area. The various potash salts were then applied at the rate of 1,000 pounds per acre on an area of 15 feet radius about each tree. As with the previous experiment, the work of further cultivation this season was prevented by the severe attack of forest caterpillars.

Figure 9. Neglected trees lose their leaves early.

In 1899, the orchard was plowed and thoroughly tilled and sprayed during June, July and August. Potash salts were applied as before. The result in the fall was most noticeable. The foliage was healthy and vigorous on all of the plots, and remained on the trees much longer than on the adjacent uncultivated and unfertilized trees. (See figures 9 and 10.) There was, however, very little fruit.

In 1900 the application of potash salts was repeated and the orchard was thoroughly harrowed during June, July and August. A heavy crop of fruit was produced, but owing to the absence of the writer from the State, no records were kept.

In 1901 the fertilizing was repeated, as in previous years. The ground was harrowed in June, July and August. A cover crop of rye was sown at the last harrowing, in August, but the season was so dry that the seed germinated poorly. The whole season was very dry, but the trees made a good fair growth and formed abundance of fruit buds for the next year.

In 1902 fertilizing was repeated as before, and the orchard

Figure 10. Cultivated and sprayed trees retain their foliage late in the season.

was thoroughly harrowed in May, June, July and August. Rye and oats were sown at the last harrowing and made an excellent growth for cover before the season closed. Spraying was omitted. An excellent crop of fruit was produced, as shown below.

YIELD OF FRUIT, 1902.

As already noted, the orchard produced a heavy crop of fruit in 1900, and practically none in 1901. The present year, again, a full crop was produced, and it is worthy of mention that the trees under discussion were almost the only ones in the whole

orchard—some 900 trees in all—which gave even a moderate yield. (The rest of the orchard is in sod as it has been for many years.) The following tabular statement of the actual yields is of interest as a matter for record and future reference.

DETAILED STATEMENT OF YIELD, 1902.

Plot.	1st row (north). No. of tree; yield.	2nd row. No. of tree; yield.	3d row. No. of tree; yield.	Average yield per tree—bbls.	Total yield of plot—bbls.	Grade of Fruit.		
						No. 1—bbls.	No. 2—bbls.	No. 3—bbls.
Kainite	1—1 bbl. 2—1½ bbl. 3—2½ bbl. 4—2 bbl. 5—vacant	1—⅓ bbl. 2—1⅔ bbl. 3—3⅓ bbl. 4—2½ bbl. 5—1½ bbl.		1.8	16.5	9.5	6	1
Sulphate	1—½ bbl. 2—4 bbl. 3—1½ bbl. 4—2 bbl. 5—1⅔ bbl.	1—2⅓ bbl. 2—3 bbl. 3—2 bbl. 4—3½ bbl. 5—2½ bbl.		2.28	22.8	14	8	.8
Check	1—1 bbl. 2—Lady apple* 3—2⅔ bbl. 4—vacant 5—1 bbl.	1—2⅓ bbl. 1—2⅓ bbl. 3—0 bbl. 4—4 bbl. 5—King*	1—2 bbl. 2—vacant 3—1⅓ bbl. 4—4 bbl. 5—4 bbl.	2.3	25.25	20.5	4.25	.5
Muriate	1—vacant 2—2 bbl. 3—3⅓ bbl. 4—4 bbl. 5—King*	1—⅓ bbl. 2—3½ bbl. 3—1⅔ bbl. 4—3¼ bbl. 5—2½ bbl.		2.6	20.5	18	2	.5

* When the orchard was originally top-worked, a few odd varieties were included

The total yield on the area under observation, nine-tenths of an acre, was 85 barrels, of which 62 barrels were commercially graded as "No. 1" and 20 barrels as "No. 2." The average yield per tree was a little less than 2½ barrels, and was remarkably uniform as between different plots. There was a noticeable increase in yield per tree and in the proportion of first-class fruit from the kainite plot to the muriate plot. This may be partly due to a slight difference in the character of the soil; the kainite plot being at the highest and the muriate at the lowest part of the slope, which, however, is very slight. The orchard was purposely left without spraying of any kind.

EFFECT OF POTASH ON APPLE SCAB.

One of the questions in mind at the beginning of this work was the supposed influence of an excess of potash in the soil as

a means of warding off the apple scab fungus. Since this question was raised other experimenters have published data bearing upon the subject, but it has been thought best to carry out the work already begun. A comparison of the results here given with those published elsewhere is not without interest.

In a way, the commercial grading as given on page 16 might be taken as an index of the condition of the fruit on the several plots. In order to get exact percentages, however, four trees, representing, as nearly as possible, the average of the whole, were selected on each plot. From each of these, two and one-half bushels of fruit, taken indiscriminately from all parts of the tree, were carefully graded and counted. The results thus obtained may be regarded as fairly indicative of the character of the fruit on each plot.

POTASH AND APPLE SCAB.

Plot.	Number of fruits examined.	Free from scab.	Slightly scabbed.	Badly scabbed.	Per cent free.	Per cent No. 1 fruit (as regards scab).
Kainite	199	79	81	39	40	80
	282	65	160	57	23	80
	383	49	243	91	13	76
	331	65	228	38	20	88
Average	**299**	**65**	**178**	**56**	**24**	**81**
Sulphate	384	68	269	47	18	88
	395	51	213	31	13	67
	396	119	238	39	30	90
	371	190	175	6	51	99
Average	**384**	**107**	**224**	**31**	**28**	**85**
Check	383	142	229	12	37	97
	334	194	139	1	58	100
	272	142	124	6	52	98
	322	135	174	13	42	96
Average	**328**	**153**	**166**	**8**	**47**	**98**
Muriate	332	190	140	2	57	99
	316	256	60	0	81	100
	390	166	222	2	42	99
	331	177	152	2	53	99
Average	**342**	**197**	**143**	**2**	**58**	**99**

As will be seen, the per cent of fruit free from scab increases regularly from the north to the south end of the orchard. The check trees, while producing nearly the same percentage of No.

1 fruit as the muriate plot next to it, gave 11 per cent less perfect fruit. On the other hand, the check trees gave 12 per cent *more* No. 1 fruit, and 19 per cent more fruit absolutely free from scab, than did the adjacent trees receiving an excess of sulphate of potash. The kainite plot gave the lowest percentage of both perfect specimens and commercially graded No. 1 fruit. As before noted, this plot is at the upper part of a very slight slope, and is perhaps a little dryer, though the trees were all making a very satisfactory growth and, during the present season, there was no lack of moisture. It may be said, however, that throughout our experience with this orchard, the worst cases of scab have invariably occurred upon the high gravelly knolls.

The results obtained agree, in the main, with those published elsewhere and it appears, from the figures given, that an excess of potash, in whatever form applied, has no effect whatever in warding off attacks of the apple scab.

III. Orchard Renovation.

The work thus far detailed was conducted in young and vigorous orchards. As a further object lesson in the management of fruit plantations, an old Baldwin orchard, planted about thirty-five years, was selected in 1902. This orchard should be in prime fruiting condition, but through neglect and as a result of repeated attacks of caterpillars and leaf rollers, it has for several years been unprofitable. Since the work has been in progress only one season, no conclusions can be drawn; but an outline of the plan of the experiment, together with a brief report of progress, is given herewith.

The orchard is located upon the western slope of a high gravelly hill. The soil is a light sandy loam, 6-8 inches deep, with gravelly or sandy subsoil. The trees were set in 1866-70 in a cultivated field which had previously produced corn, wheat, and general farm crops; but after a very few years the orchard was used as a sheep pasture, the trees being frequently mulched while young. No further attention was given the trees, save an occasional slight pruning, until May, 1892, when the whole orchard received an application of bone and muriate of potash. The same summer hogs were turned in, and they thoroughly stirred the soil and started the trees into vigorous growth. A very large crop of fruit was produced in 1893 and again in 1896, but since that

date the trees have done practically nothing. Since 1892 the orchard has received no treatment, except spraying, until the present year when a portion of it, as indicated in the diagram, was thoroughly tilled and variously fertilized.

The fertilizers used in 1902 were as follows:

Plat 1—Muriate of potash 75 lbs; acid rock 75 lbs; nitrate of soda 50 lbs.

Plat 2—Muriate of potash 75 lbs; acid rock 75 lbs.

Plat 3—Nitrate of soda 50 lbs; acid rock 75 lbs.

Plat 4—Acid rock 75 lbs.

Plat 5—Muriate of potash 75 lbs.

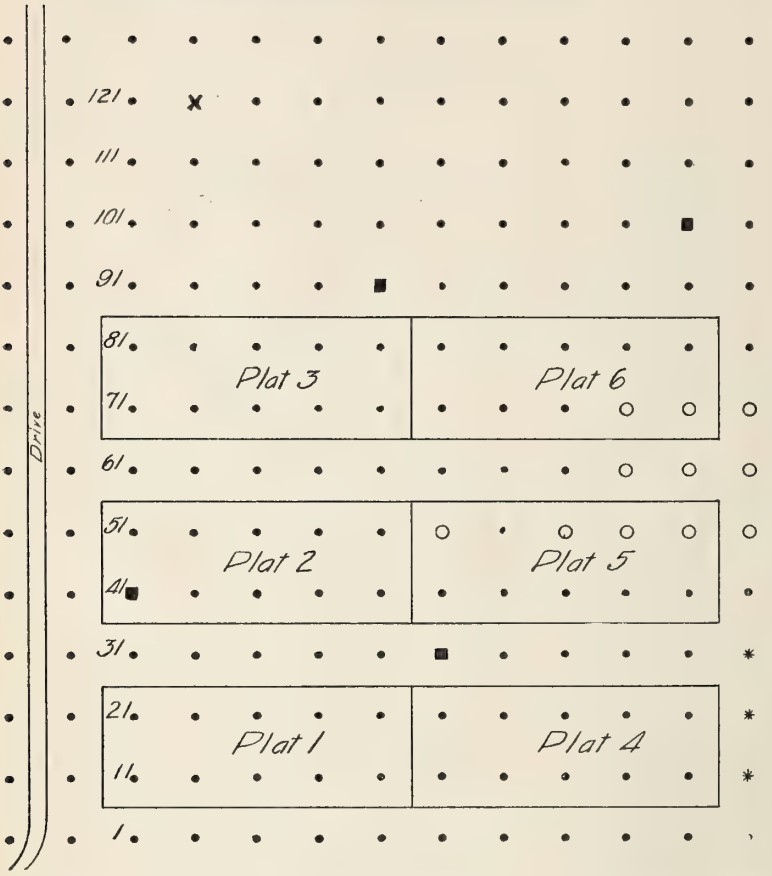
Plat 6—Nitrate of soda 50 lbs.

Without going into details, it may be said that the effect of culture, on the whole block, was most marked, being very distinctly visible from a hill-side half a mile distant. The foliage of the cultivated trees was large, healthy, dark green, and the trees made a good growth, while the adjacent check trees were of a pale, yellowish-green color, made practically no growth, and are in no condition for producing fruit next year. (Owing to previous conditions very few of the trees, either cultivated or otherwise, bore fruit this year).

As might be expected, the plot receiving a complete fertilizer presented the best appearance at the end of the growing season. The use of nitrogen alone increased the growth to a marked degree (though less than the complete fertilizer) but there was a noticeable lack of color in the fruit. Trees on the plot receiving acid rock alone, in general, seemed no better than the check trees which were cultivated but not fertilized. Potash alone, on the other hand, produced a distinct improvement.

The bud-moth and the leaf-roller made such havoc in many cases that trees not growing rapidly were very severely injured and one lesson from an observation of this orchard is obvious, *viz:* To insure against damage from the insects mentioned we must *feed* and *cultivate,* thus forcing growth after the insects have finished their work. The importance of spraying with Paris green as a preventive measure is not, however, to be overlooked. But in order to be effective, the spraying must be done before the buds unfold, for the bud-moth, and just as soon as leaves appear for the leaf roller.

ORCHARD RENOVATION.—DIAGRAM OF THE ORCHARD.



Explanation of Diagram: All of the trees in the orchard are Baldwins except the following: ⁂=pear tree; O=Gravenstein; ×=Sutton Beauty; ■=vacancy.

IV. The Top-Working of Orchards.

Many of the smaller orchards of Maine consist principally of varieties which produce early fruit, or fruit which is of inferior quality or of unknown market value. Such trees, by top-grafting to more valuable sorts, may be made a valuable source of income, instead of an eye-sore and a reflection on the thrift and good judgment of the owner. Every owner of apple trees should know how to perform this simple but important operation, and in no case is it safe to depend upon "professional grafters."

Top-working by cleft-grafting, which is the most common method, may be performed with very little loss of time. In no case, however, should an old tree be cut back to a few large stubs and cions inserted in these with the hope of satisfactory results. The proper method of top-grafting an old tree is not to make a few large limbs the basis of the new top, but to remove a larger number of small limbs ranging from one to two inches in diameter. In all this work, too, the symmetry of the tree should be preserved by cutting the stubs at a nearly uniform distance from the center of the top. In this way the long naked limbs so often seen may be avoided. The cleft in the stub should be in a horizontal position; in other words, the cions should stand so that one is not above the other. After a year or so, when the stub is well healed over, one of the cions should be cut out.

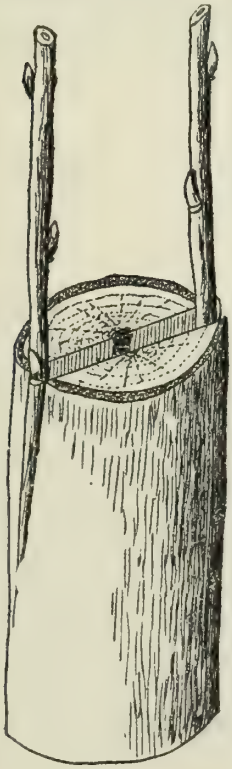


Figure 11.

The method of making the cleft graft is very simple. The cions, which are usually from three to six inches long, are made wedge shaped at the lower end and one side of the wedge is a little thinner than the other. A bud is usually left near the upper outer side of the wedge. The stub is split as before suggested, and the cions are inserted as shown in Figure 11, care being taken that the line between wood and bark on the cion just matches that on the stock. Figure 11 shows the graft ready for waxing; Figure 12 is a cross-section just at the end of the stub.

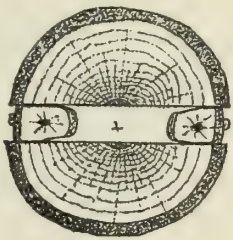


Figure 12.

Figure 13. A young tree before top-grafting.

Figure 14. A young tree after top-grafting.

Waxing is one of the most important factors in successful grafting. The work must be done carefully, that the cions be not disturbed, and completely, that all air and moisture shall be excluded. A very good wax is made by melting together four pounds of resin, two pounds of beeswax and one pound of tallow. When melted, pour into a tub of cold water to cool; then pull, the same as for taffy, until it is of a clear golden color. Of course grafting should be done on warm, bright days; otherwise the wax hardens so quickly it is difficult to do the work well.

Young trees may be re-topped in a single season; a tree eight to ten years old in two years, and one of twenty or more years

Figure 15. A top-worked tree showing a defective seedling stock.

in three seasons. Of the accompanying illustrations, Figure 13 shows a six-year-old tree in the Station orchard before top-grafting. Figure 14 shows the same tree after the operation. Three years later the new top produced one bushel of fruit.

The suggestion to top-graft orchard trees—like most other advice—must be followed intelligently and adapted to specific needs and conditions. At the present time, however, the top-working of certain varieties, like the Baldwin, is highly recommended for general orchard practice by some of the most successful growers. There must be some reason, real or imaginary,

for the supposed advantage of this method. For more than a hundred years the mutual influence of stock and cion has been a fertile subject for discussion, but even now there is comparatively little positive and definite information on the subject. There are some facts which go to show that the stock may have a perceptible influence upon the produce of the graft. Aside from a specific recognizable effect upon the fruit, however, there is little doubt of the importance of using some standard hardy variety, such as Spy, Stark, or Pewaukee, as a basis for a top-worked orchard. The Baldwin, in certain sections of the State, is a very unsatisfactory orchard variety because of body blight and sun scald; but when top-worked, as indicated, it often does admirably. Individual seedling apple trees vary just as much in vigor and hardiness as do other seedling plants. Hence the importance of using as stock some variety of known vigor and hardiness rather than a miscellaneous collection of seedlings. Not infrequently the inherent weakness of a seedling stock will manifest itself just as the tree reaches the bearing age: with the result that the orchard is spotted and unsatisfactory. Figure 15 shows such a case on the cultivated plot described on pages 5-8. This tree bore nearly a barrel of fruit this year, but made no growth, dropped its leaves early, and will probably fail to start next spring.

Another advantage of top-working the variety desired is that cions may be selected from particular trees of known value. Cions taken from a tree producing large quantities of highly colored fruit, true to type, will be likely to give satisfactory returns when taken to the new orchard. On the other hand, nursery grown stock may have come from buds taken from other nursery trees or from trees which produced fruit of inferior quality and appearance, and these undesirable qualities are just as certain of being perpetuated as are the others,—a fact which doubtless accounts for many unsatisfactory orchards.

Bulletin 88 of the Station, to be dated December, 1902, will contain the reprints of newspaper bulletins issued in 1902, the report of the treasurer, meteorological report and the index to bulletins issued in 1902. As this publication is not of general interest, only a small edition will be printed and it will not be sent to residents of Maine. It will be sent to the addresses on the list furnished by the Office of Experiment Stations and will appear in the annual report of the Station, which will be bound with that of the Commissioner of Agriculture and distributed by him.

Residents of Maine desiring copies of this bulletin will be supplied on application to the Station.